

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to the Abstraction of Water from Water Bearing Strata

We, RANNEY METHOD WATER SUPPLIES, INC., a corporation organised under the laws of West Virginia, United States of America, of 68, South High Street, Columbus, County of Franklin, and State of Ohio, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

The present invention concerns an arrangement for withdrawing water from water-bearing strata, which includes a hollow shaft or caisson with at least one perforated pipe extending radially from said shaft or caisson and having co-axially arranged therein, a discharge pipe or sand line with the outer end thereof forming a cone-shaped head. The said perforated pipe has arranged therein adjacent said head, a partition provided with a bore which is intended to receive one end of the discharge pipe. Arrangements of this type are known, but the arrangements heretofore used have been inadequate for removing the fine sand and silt which necessarily collects in the perforated pipe when driving the same in radial direction into the area surrounding the caisson. The reason for this inadequacy consists in that according to the heretofore known arrangements, the discharge pipe or sand line is screwed into the bore provided in the above-mentioned partition, and once being withdrawn from said partition after the pipe has been driven in radial direction, it cannot be re-introduced into the said threaded bore. On the other hand, during the actual projection of the perforated pipe into the area surrounding the caisson, it is, in most instances, impossible to prevent the fine sand and silt from clogging up the head to such an extent that as long as the discharge pipe remains in the bore, no sand or silt can be withdrawn therethrough. Whenever this occurs, it is necessary to withdraw the discharge pipe, at least to

such an extent that water passing through the perforations in the perforated pipe, will leach out the sand or silt from the head. When the head has thus been cleaned, it is necessary to return the discharge pipe to its previous position, in order to exploit the total pressure of the water surrounding the head and the perforated pipe for pressing fine sand and silt into the head and withdrawing the same through the discharge pipe. However, with the arrangements heretofore known and referred to above, it was impossible to return the discharge pipe to its previous position in which it threadedly engages the threaded bore. In the first place, due to considerable length of the perforated pipe and also of the discharge pipe, slight deviations from the horizontal are unavoidable, and thus it is practically impossible to find the threaded bore in the partition. Secondly, even if by chance, or after considerable time of trying, the threaded bore in the partition was located, it was impossible to engage the thread of said bore with the thread of the discharge pipe in the proper manner and then to rotate the pipe in order to screw the same into the head. This was due to the fact that the axes of the threaded bore and the discharge pipe formed an angle with each other, and furthermore, due to the fact that fine silt or sand lodged in the grooves of the thread. The above-mentioned drawbacks have been overcome in a very simple manner by the arrangement according to the present invention, which is characterised in that the partition is provided with a cone-shaped bore for supporting and guiding the discharge pipe or sand line toward the head and allowing sliding movement of said pipe or line in its axial direction, said bore tapering toward the head so as to form an abutment for said pipe or line to limit the outward movement of said pipe or line toward the outer end of said head.

With the arrangement according to the

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present invention, the deviations of the longitudinal axis of the discharge pipe relative to the longitudinal axis of the perforated pipe, does not handicap the proper locating of the discharge pipe, inasmuch as the cone-shaped bore in the partition automatically guides the discharge pipe into its proper position.

According to a further development of the invention, the outer end of the discharge pipe is bevelled in conformity with the cone shaped bore in the partition adjacent the head. This bevelled surface will not only facilitate the sliding of the outer end of the discharge pipe in the cone-shaped bore, but will, at the same time in co-operation with the conical surface of the last-mentioned bore, provide an effective seal between the said conical surface of the bore and the outside of the discharge pipe. This, in turn, contributes to a better exploitation of the hydrostatic pressure around the head of the perforated pipe for removing fine sand and silt from the interior of the head.

The invention is illustrated by way of example in the accompanying drawings, in which:—

Figure 1 represents a vertical section through a typical installation of the device according to the invention.

Figure 2 is a section along the line 2—2 of Figure 1 and shows the radial arrangement of the screen pipes.

Figure 3 shows in a section on a scale larger than that of Figure 1, a portion of the wall of the caisson illustrating the plugging of the horizontal hole which receives the screen pipe and its associated mechanism.

Figure 4 is a section similar to that of Figure 3 but with the screen pipe, its water pipe, packings, valve pipe, and valve arranged in proper position.

Figure 5 is an exploded sectional view of an adjustable packer to be mounted between the exterior of the water pipe and the interior of the screen pipe.

Figure 6 is an end elevation of a connecting sleeve.

Figure 7 shows in plan view the arrangement of the several valves for controlling the discharge of water and of any accumulated silt, fines, and the like.

Figures 8, 9 and 10 show a portion of a screen pipe of the invention in section with the water pipe in three different positions.

Figure 11 is a section taken along the line 11—11 of Figure 8.

Figure 12 is a section taken along the line 12—12 of Figure 10.

Referring now to the drawings in detail, and Figures 1 and 2 thereof in particular, the structure shown therein

represents a water collector installation arranged near a stream 2 and having its control or pump house 1 spaced from and above the top of the ground or soil 1a. In the structure shown, the control house 1 is supported by a hollow and preferably monolithic reinforced concrete shaft or caisson 3. The lower end of this caisson 3 is closed by a concrete plug 4. Adjacent to, but somewhat above the plug 4, there is a plurality of radially disposed openings or precast port holes 5 through which extend radially disposed perforated screen pipes 6. Each screen pipe is surrounded by a bed 11 of gravel which may for instance be from four to six feet in diameter. Arranged on the inner end of each of these screen pipes 6 is a gate valve 7 with a stem 7a and handle 7c extending to a valve operation platform 7b which is accessible from the pump house 1 so that any or all of the screen pipes 6 may be closed off at will. Multiple-stage deep well pumps 9 extend down into the caisson 3, which is a clear well, by means of a pipe system 9a to withdraw water from the underground reservoir to the water main 10.

An installation as outlined above is built up by first sinking the shaft or caisson 3 down through the water bearing strata and sealing the bottom of the caisson with the heavy reinforced concrete plug 4. The lower part of the caisson is, as stated above, formed with pre-cast port holes 5 for the passage of the screen pipes 6 therethrough. Figures 3 and 4 show such a port hole, which has a diameter materially larger than the outer diameter of the screen pipe to be passed therethrough. Furthermore, the inner surface of the port hole 5 is corrugated and provided with a correspondingly shaped liner 31a. To prevent the clogging up of the port hole 5 is corrugated and being lowered into the ground, each port hole is temporarily closed by detachable plugs 32 (see Figure 3) held in their respective positions by means of a bolt 33. If it is now intended, after the lower part of the caisson has been properly positioned, to pass the screen pipes through the port holes, the plugs 32 are removed, and one sleeve 34 is inserted into each port hole and properly located therein. Thereupon, concrete is poured between the liner 31a in the port hole 5 and the outside of the sleeve 34, so that the sleeve 34 will be firmly anchored when the concrete has hardened. Now the armature 37a without the valve 7 proper, but with the opening, to which valve 7 is normally connected, closed, e.g. by a lid, is connected to the sleeve 34 after the sealing member 39 has been placed between the flange 36 and

of the sleeve 34 and the flange 37 of the armature 37a. Bolts 38 connect the armature 37a to the sleeve 34. Before the screen pipes 6 are projected through the skirt 40 of the sealing member 39 into the water bearing strata, the sealing assemblies 24, 27, to be described in detail later, are installed in the respective screen pipes, whereupon the first screen 10 pipe sections are projected horizontally outwardly into the water bearing strata through the respective port holes 5. The sealing assemblies 24, 27 remain in the respective screen pipes throughout the entire projection period. The purpose of the sealing assembly is to prevent the flow of water through the interior of the screen pipe into the caisson. The perforated collector pipes 6 which may, for 15 instance, be eight inches in diameter, are built up to the desired length by forcing relatively short pipes out through the port holes and welding new pipes thereto before the pipes are pushed out completely. The same method may also be employed for building up the discharge pipes or sand lines 8 to be referred to in detail later, and these pipes 8 can thereafter be removed by cutting them up into 20 very short sections. During this operation the water entering the pipe 6 is withdrawn through the discharge pipe 8. The number of the pipes 6 is, of course, determined upon the basis of capacity of 25 water desired and hydrogeological conditions encountered.

When driving the screen collector pipes 6 with their associated mechanism outwardly through the port holes 5 in a horizontal plane, it is of great importance 30 that the fine sand and silt present in the strata surrounding the screen pipes be removed from said strata so as to create a relatively coarse gravel bed of high 35 permeability, preferably in excess of four feet in diameter, around each screen pipe. These fines are removed through the screen pipes 6 and discharge pipes 8, by pumping or in any other convenient 40 manner. When each screen pipe has been projected to the finally desired extent, the clean-out valve 42 is connected. The armature 37a is temporarily removed, and the screen pipe 6 is cut off at the face of 45 the flange 36, while the sealing assembly 24, 27 and sand line 8 are left in place. The armature 37a is now again connected to flange 36, and valve 7 is connected to the armature 36 as shown in dot-dash lines 50 (Figure 4). The cleanout valve 42 is then connected through its pipe sections 48 and 44, and by means of the flange 45 and bolts 38a to the flange 46 of the armature 37a. Thereupon, the sealing assemblies 24, 25 55 are withdrawn into the rear horizontal portion 44 of said valve 42 so that a through passage for the water from the strata to the valve 42 is available. Then the final clean out of the screen pipe may be effected through the clean-out valve 42 to remove the fine sand and silt remaining in the screen pipe after completion of the projecting operation. This is of great importance, since it permits an easy removal of the sand line which sometimes becomes sand bound in the screen pipe. After this clean-out operation has been completed, the pipe 8 is hauled out through the sealing assembly 24, 25 and the gland in the rear of the portion 44, thus permitting the valve 7 to be shut down and the removal of the assembly 42, 43, 24, 25 without water entering the caisson. Then, the valve assembly 42, 43, 44 is removed. Finally, a lid (not shown in the drawing), is connected to flange 46 to close the outer end of the armature 37a. This completes the installation.

One of the greatest problems presenting itself in connection with an installation of the type outlined above consists in properly guiding the sand lines in and maintaining the same in proper alignment with the respective screen pipes during the installation period.

This problem has been taken care of by the construction of the screen pipes according to the invention as illustrated in Figures 4 to 12. As will be seen from these figures, the screen pipe 6 consists primarily of a tubular member 14 with perforations 14a, and a conical streamlined nose 12 detachably connected at 13 to the tubular member 14 and provided with perforations or openings 15. The perforations 14a and 15 are preferably so shaped that they are wider on the inside of the members 14 and 12 than on the outside thereof.

Arranged at the outer end of the tubular member 14 adjacent the nose or head 12, is an abutment or guiding member 16 having substantially centrally arranged therein, a tapered bore 17 which tapers toward the outside and ends in a passageway 18 communicating with the interior of the nose 12. Spaced from the guiding member 16 but in alignment therewith, is at least a second guiding member 20 with a bore 22 therethrough which tapers into a cylindrical passageway 21 likewise provided in the guiding member 20. The abutment member 16, while serving primarily as an abutment for the discharge pipe 8 and also as a guide and support for the front end thereof, forms a partition between the nose 12 on one hand, and a cylindrical chamber on the other hand, which chamber is formed between the outer wall of pipe 8 and inner wall of 100

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tubular member 14. The guiding member 20 acts as a guide and support for the discharge pipe 8 and also as a partition similar to the abutment member 16. The rear end of the discharge pipe 8 is carried by a number of sealing members 24 spaced from each other by spacer sleeves 27. These spacer sleeves are provided with flanges 28 and 29 riveted to the adjacent sealing members. As will be clear from Figure 5, each sealing member has an inner skirt 26 which tightly surrounds and supports the adjacent part of the discharge pipe 8. Each sealing member 24 furthermore has an outer skirt 25 for sealing engagement with the inner surface of the tubular member 14. The sealing members 24, together with the spacer sleeves 27, form a flexible chain of washers forming a unit that will withstand horizontal thrust while being able to bend with the movement of the discharge pipe 8 and screen pipe 6. This sealing unit may also be adjusted in its entirety, and, to this end, it is provided with an eye 30 having connected thereto a rod or cable 31 which extends to the rear of the respective screen pipe 6 so as to be able to be actuated through the respective port hole 5. It is of course understood that the length of the sealing unit may be varied in accordance with the specific requirements encountered by merely varying the number of sealing members 24 and spacer sleeves 27.

Figures 8, 9 and 10 illustrate three different positions which the discharge pipe 8 may occupy during the installation period. According to Figure 10, the pipe 8 is withdrawn from both the guiding Figure 10 that the entire interior of the screen pipe is free so that the water from the water bearing strata can rush into the screen pipe and the turbulence obtained thereby can cause the fine silt and sand to suspend in the water, thereby enabling efficient, quick, and thorough clean-out operation of the screen pipe by means of a suction pump. This clean-out is of extreme importance during the installation of the device, when, as previously outlined, all the fine sand, silt and the like must be withdrawn from the area surrounding the screen pipe in order to build up a relatively coarse gravel bed around the screen pipe. It will be obvious that, when thus all fine sand and silt has been removed from the bed surrounding the screen pipe, no fine sand, silt or the like will accumulate within the screen pipe and cause the latter to sag, bend or otherwise to deviate from the desired horizontal position.

Figure 9 shows the discharge pipe 8 in an intermediate position in which it

extends through the guiding member 20 but is spaced from the abutment 16. Since the opening 21 is somewhat larger than the outer diameter of pipe 8, the inner space of the screen pipe located between the guiding member 20 and the end of the pipe adjacent the sealing assemblies of the nose 12 still communicates, although in restricted manner, with the pump or the like at the end of the screen pipe, while free communication exists between the inner space of the screen pipe located between the guiding member 20 and the tip of the nose 12, and the interior of pipe 8. Consequently the turbidity in this instance will be less than when the pipe 8 occupies Figure 10 position.

Figure 8 shows the discharge pipe 8 in its outward position in which its bevelled surface 19 engages the tapered bore 17 of the abutment member 16. This is the position normally occupied by the pipe 8 when the screen pipe is being driven forward, e.g., when most of the sand and silt enters the head 12. In this position of the pipe 8, the greatest portion of the sand and silt entering from the outside will be quickly removed from the head 12 through pipe 8.

From the above, it will be clear that the longitudinally adjustable discharge pipe 8 within the screen pipe 6, is highly beneficial for properly locating the screen pipe during the installment of the entire water operation of the screen pipe by means of a collecting system, inasmuch as the adjustable pipe 8 makes it possible quickly and efficiently to withdraw silt and fine sand from the screen pipe. Also, if later, after the system has been in operation for some time, silt and fine sand accumulations should occur due to some circumstances in the screen pipe, the pipe 8 can easily be reintroduced, if desired, and be moved into Figure 9 or 10 position to stir up the sand or silt and to remove it as described above. On the other hand, during the installation of the water collecting system, the sealing means 40, 24 and 26 will prevent any substantial leakage or seepage along the pipe surfaces engaged by said sealing means, even if the screen pipe 6 is not in proper alignment with the respective port hole and if the pipe 8 is not quite concentrically arranged within the screen pipe 14.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:

1. An arrangement for withdrawing water from water bearing strata, which includes a hollow shaft or caisson with at least one perforated pipe extending radi-

ally from said shaft or caisson and having co-axially arranged therein a discharge pipe or sand line, with the outer end thereof forming a cone-shaped head, said 5 perforated pipe having therein and adjacent said head, a partition provided with a bore characterised in that the partition is provided with a cone-shaped bore for supporting and guiding the discharge 10 pipe or sand line toward the head and allowing sliding movement of said discharge pipe or sand line in its axial direction, said bore tapering toward the head so as to form an abutment for said discharge pipe or sand line to limit the outward movement of said discharge pipe or sand line towards the outer end of said head.

2. An arrangement according to Claim 20 1, in which the perforated pipe has provided therein, a second partition spaced from the first-mentioned partition at a predetermined distance and provided with a cone-shaped bore for guiding and supporting the discharge pipe or sand line.

3. An arrangement according to Claim 2, in which the cone-shaped bore of the second partition ends in a cylindrical passageway having an inner diameter 30 larger than the outer diameter of the discharge pipe or sand line.

4. An arrangement according to any of Claims 1 to 3, characterised in that the outer end of the discharge pipe or sand 35 line is bevelled in conformity with the cone-shaped bore in the partition adjacent the head.

5. An arrangement according to any of Claims 1 to 4, characterised by flexible sealing means interposed between the discharge pipe or sand line and the perforated pipe pertaining thereto.

6. An arrangement according to any of Claims 1 to 5, in which the perforated pipe extends through port holes in the shaft or caisson, characterised in that a sleeve spaced from and surrounding a portion of the perforated pipe, is anchored in concrete provided in said port holes, while a flexible sealing member is provided 50 between said sleeve and said portion of the perforated pipe.

7. An arrangement according to Claim 5, in which the sealing means consists of a plurality of centrally apertured rings of 55 flexible material interconnected by rigid cylindrical spacer elements.

8. An arrangement according to Claim 7, characterised in that the sealing means are adjustable as a unit.

9. An arrangement for withdrawing water from water bearing strata substantially as hereinbefore described with reference to the accompanying drawings.

Dated the 22nd day of September, 1947.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Jessel Chambers, 88/90, Chancery Lane,
London, W.C.2, and
Central House, 75, New Street,
Birmingham, 2,
Agents for the Applicants.

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FIG. I

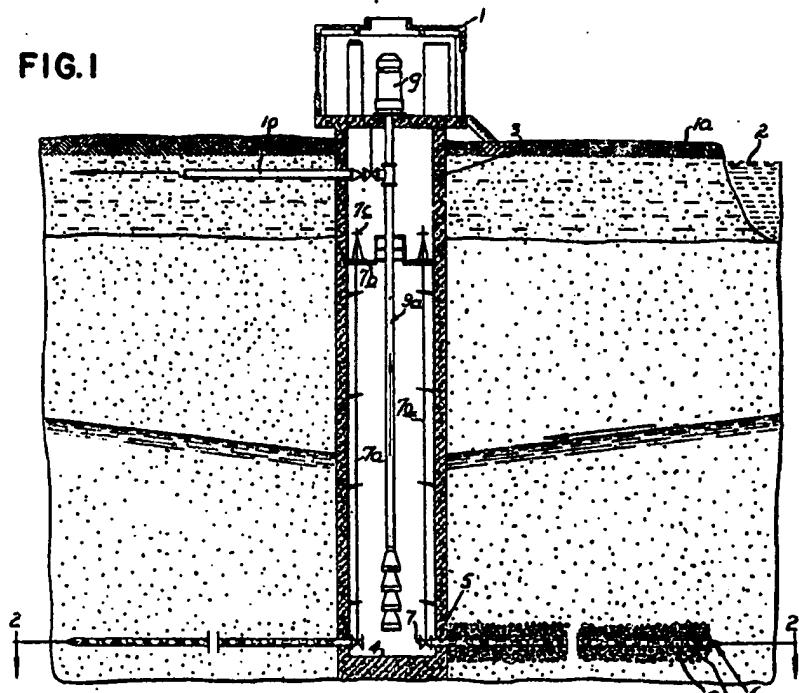
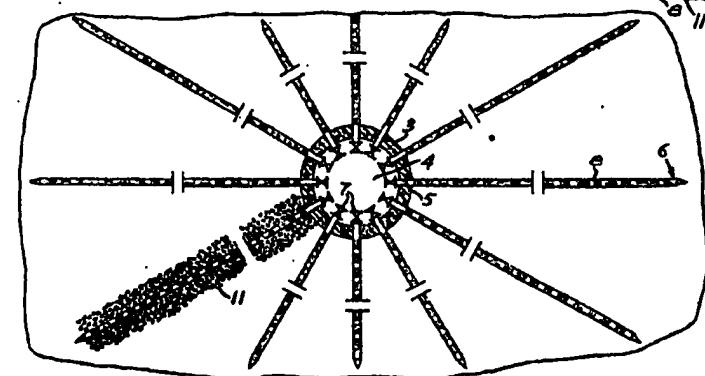


FIG. 2



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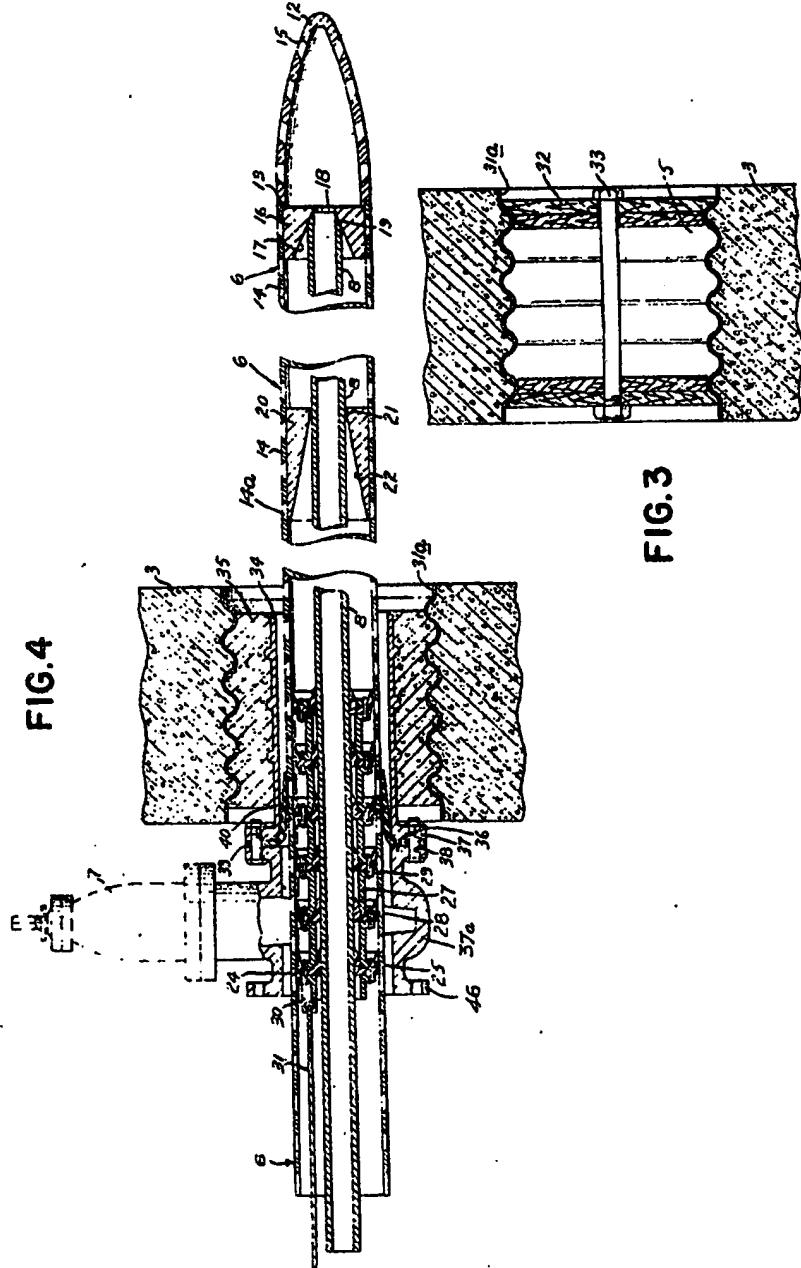
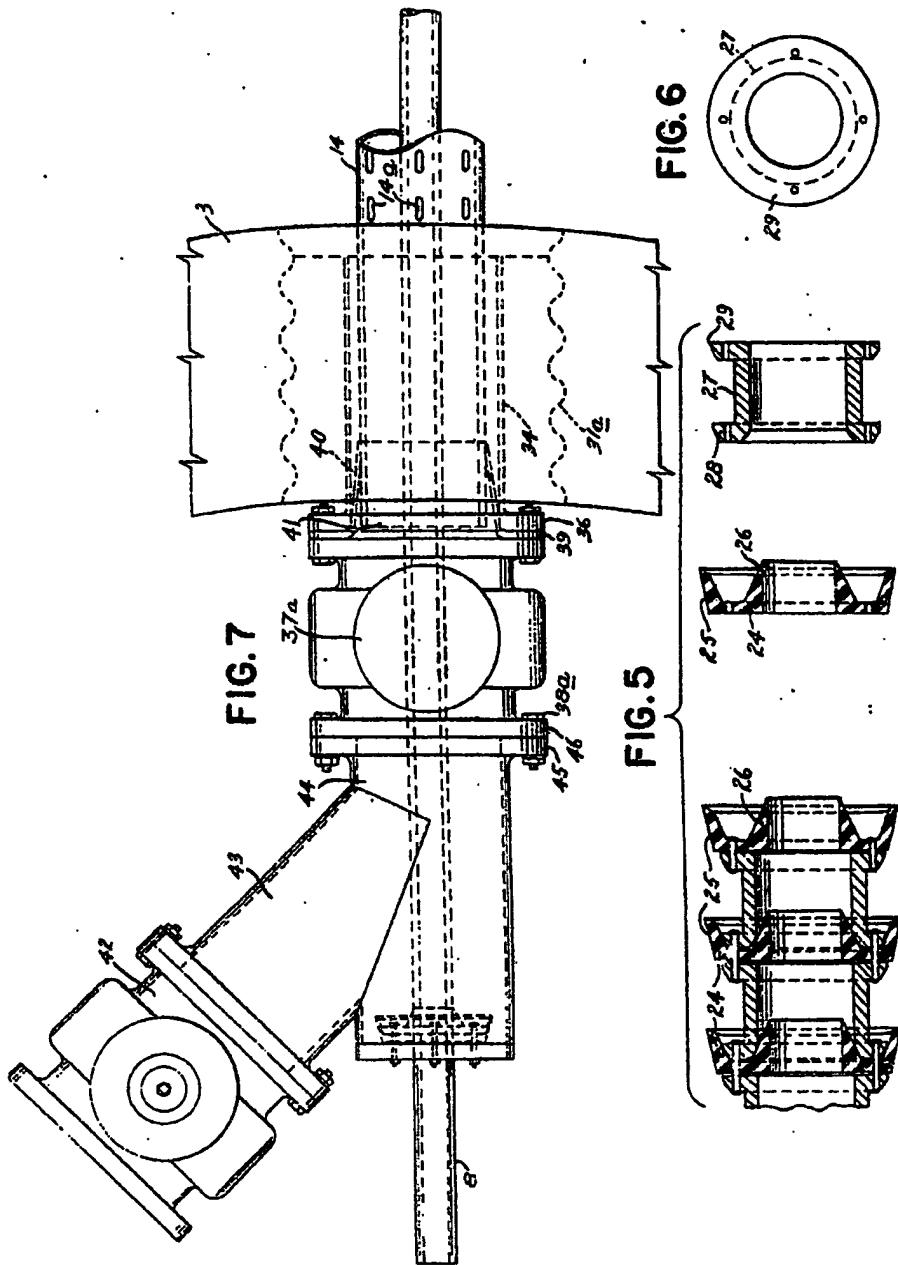


FIG. 3

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SHEET 3

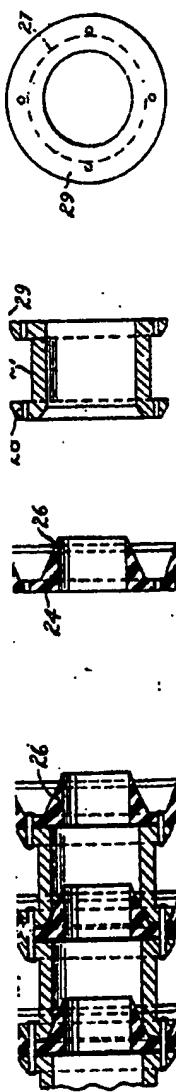


FIG. 8

FIG. 11

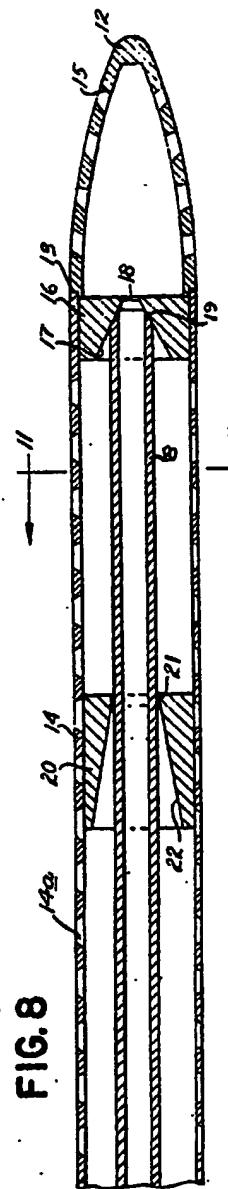
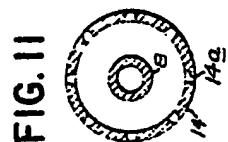


FIG. 9

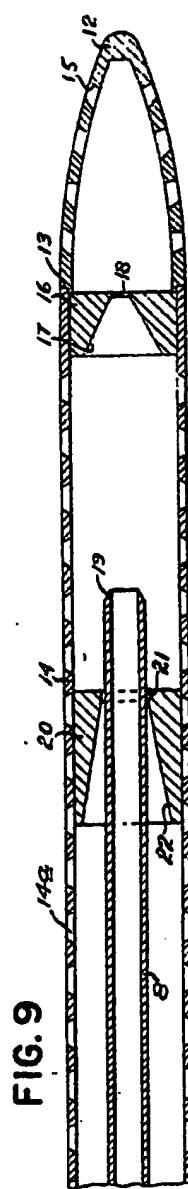
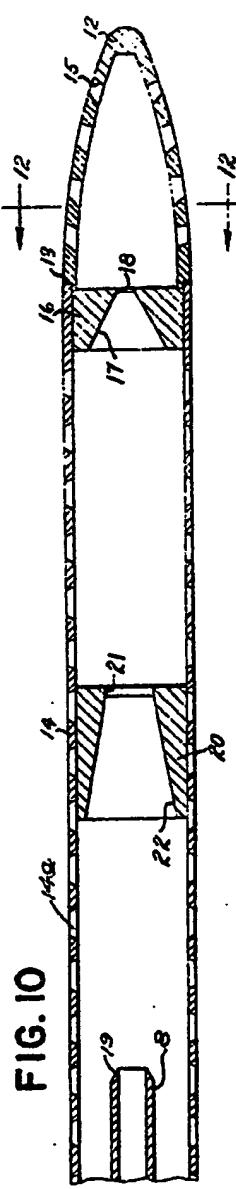
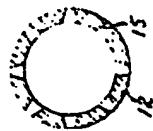


FIG. 10



4 SHEETS
SHEET 4

FIG. 12



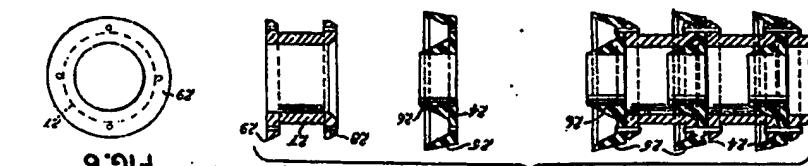


FIG. 6

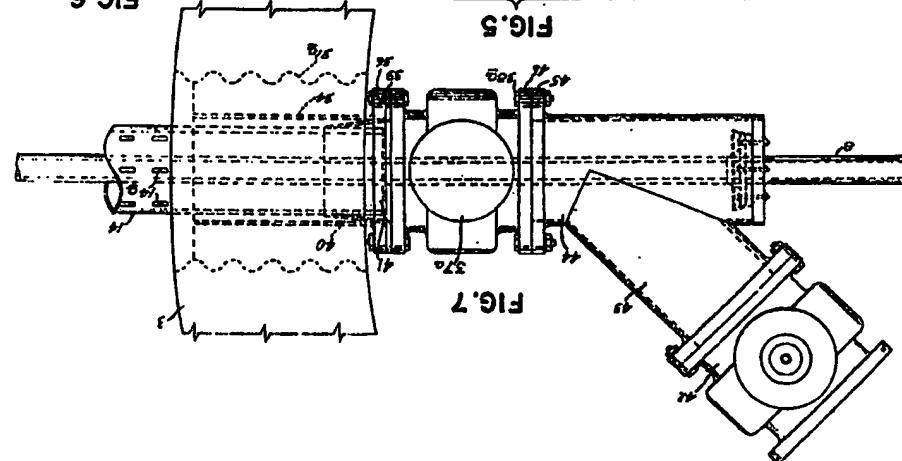


Fig.

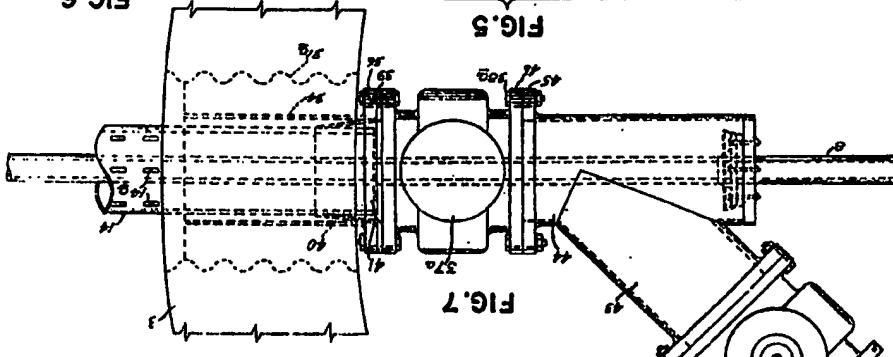


FIG. 5

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